

REMARKS

Claims 48 and 49 stand rejected under 35 U.S.C. § 112, first paragraph, as allegedly failing to comply with the written description requirement. Applicant respectfully traverses this rejection.

Applicant has amended Claims 48 and 49 to remove the language relating to the oxygen content. Accordingly, withdrawal of this rejection is respectfully requested.

Claims 1, 3-7 and 44 stand rejected under 35 U.S.C. §102(b) as being anticipated by United States Patent No. 5,070,036 to Stevens. Applicant has canceled Claims 4, 7 and 44, without prejudice, thereby rendering this rejection moot with respect to these claims. However, with respect to Claims 1, 3, 5 and 6, Applicant respectfully traverses this rejection.

Applicant respectfully submits that the Stevens reference fails to disclose all of the features of the present invention. Specifically, the Stevens reference fails to disclose the claimed invention as defined in independent Claims 1 and 3, which includes, *inter alia*, a barrier layer, a metal growth promoting layer, and an electroconductive layer, where the electroconductive layer is formed directly on the metal growth promoting layer, and further where the embedded electroconductive layer is “a Cu layer, an Al layer or an Al alloy layer having Al as a main component thereof.” Nor does the Stevens reference disclose the claimed invention as defined in independent Claim 5, which includes, *inter alia*, a ground layer and an electroconductive layer, where the electroconductive layer is formed directly on

the upper part of the ground layer, and further where the embedded electroconductive layer is “a Cu layer, an Al layer or an Al alloy layer having Al as a main component thereof.”

In Amendment D, Applicant argued that the Stevens reference fails to disclose the invention defined in independent Claims 1, 3 and 5 because it failed to include an electroconductive layer formed “directly on” the metal growth promoting layer (Claims 1 and 3) or an electroconductive layer formed “directly on” an upper part of the ground layer (Claim 5). In response, the Examiner argued that he considered both layer 8 and layer 9 of Stevens to be equivalent to the claimed electroconductive layer. Although Applicant disagrees that these two layers can be considered as the claimed single electroconductive layer, Applicant has amended independent Claims 1, 3 and 5 (by incorporating therein the subject matter of now-cancelled dependent claims 4, 7, and 44) to more specifically recite that the electroconductive layer is “a Cu layer, an Al layer or an Al alloy layer having Al as a main component thereof” (emphasis added). Accordingly, Applicant respectfully submits that the §102(b) rejection of Claims 1, 3 and 5 under Stevens should be withdrawn because the layer structure of Stevens that consists of two layers (layer 8 and layer 9) of different materials cannot be considered as the claimed electroconductive layer that comprises either a Cu layer, an Al layer, an Al alloy layer, as defined in independent Claims 1, 3 and 5. Therefore, Applicant respectfully requests the withdrawal of this §102(b) rejection of Claims 1, 3, and 5 under Stevens.

Further, the layers of the Stevens reference perform different functions than the layers of the present invention. First, with regard to Claim 1, the present invention includes

an electroconductive layer formed of a Cu layer, an Al layer, or an Al alloy layer, where the electroconductive layer is formed directly on a growth promoting layer made of a refractory metal nitride. Accordingly, the growth promoting layer results in promoting the growth of a metal layer made of Cu, Al or and Al alloy.

In contrast, in the Stevens reference, a Ti layer 8 (which also contains Al, Si, O, and/or N) is interposed between the lower oxygen content titanium nitride layer 7 (which the Examiner equated with the claimed metal growth promoting layer) and an Al alloy layer 9. The Ti layer 8 forms a strong bond between regions 7 and 9, and serves as a barrier to impede unwanted reactions therebetween. Accordingly, the Ti layer 8 is a necessary element of the device of Stevens. Although the Ti layer 8 of Stevens may contain nitrogen, the material of Ti layer 8 is not titanium nitride, but is instead an aluminum-titanium compound, as described in column 8, line 9 of Stevens. Additionally, Stevens fails to describe that the Ti layer 8 serves as a metal growth promoting layer. Further, the Ti layer 8 is extremely active, and thus corrosion of an underlying layer is easily caused when depositing a Cu layer and an Al layer. Thus, the structure of Stevens lacks reliability. Moreover, Ti layer 8 easily absorbs oxygen when exposed to the air, and thus it is difficult to employ it as a metal growth promoting layer.

With regard to Claim 3, the present invention of this claim includes a metal growth promoting layer consisting of a TiN layer that has a lower oxygen concentration than the barrier layer. In the invention of this claim, since an electroconductive layer formed of a

Cu layer, an Al layer or an Al alloy layer is formed directly on the metal growth promoting layer, growth of the Cu layer, the Al layer or the Al alloy layer is promoted.

In contrast, in Stevens, the Ti layer 8 is interposed between the low oxygen content titanium nitride layer 7 and the Al alloy layer 9. Additionally, as also mentioned above, Ti layer 8 is not titanium nitride, and there is no description that Ti layer 8 serves as a metal growth promoting layer.

With regard to Claim 5, the present invention of this claim includes an electroconductive layer formed of a Cu layer, an Al layer or an Al alloy layer, where the electroconductive layer is formed directly on an upper layer (metal growth promoting layer) of a ground layer. Since the electroconductive layer is formed directly on the upper layer of the ground layer, growth of the Cu layer, the Al layer, or the Al alloy layer is promoted.

In contrast, Stevens discloses a multi-layered structure formed of an MON layer 6 (a metal oxynitride layer); a low oxygen content TiN layer 7; a Ti layer 8 (containing Al, Si, O, and/or N); and an Al alloy layer 9. The Ti layer 8 is interposed between the low oxygen content TiN layer 7 and the Al alloy layer 9. Additionally, there is no description that the Ti layer 8 serves as a metal growth promoting layer.

Accordingly, for all of the above reasons, Applicant respectfully requests the withdrawal of this §102(b) rejection of independent Claims 1, 3 and 5.

Claim 6 depends from independent Claim 5, and therefore includes all of the features of Claim 5, plus additional features. Accordingly, Applicant respectfully requests

that the §102(b) rejection of dependent Claim 6 under Stevens be withdrawn considering the above remarks directed to independent Claims 1, 3, and 5.

Claims 2, 40 and 41 stand rejected under 35 U.S.C. §103 as being unpatentable over Stevens in view of United States Patent No. 4,910,169 to Hoshino. Applicant respectfully traverses this rejection.

Claims 2, 40 and 41 all depend from either independent Claim 1 or from independent Claim 3, and therefore include all of the features of either Claim 1 or Claim 3, plus additional features. Accordingly, Applicant respectfully requests that the §103 rejections of dependent Claims 2, 40 and 41 be withdrawn considering the above remarks directed to independent Claims 1 and 3, and also because the Hoshino reference does not remedy the deficiencies in the Stevens device discussed above, nor was this reference relied upon for the features discussed above.

Claim 37 stands rejected under 35 U.S.C. §103 as being unpatentable over Stevens. Applicant respectfully traverses this rejection.

Claim 37 depends from independent Claim 1, and therefore includes all of the features of Claim 1, plus additional features. Accordingly, Applicant respectfully requests that the §103 rejection of dependent Claim 37 be withdrawn considering the above remarks directed to independent Claim 1, and also because the Stevens reference does not suggest that layers 8 and 9 should be modified into “a Cu layer, an Al layer or an Al alloy layer.”

Claim 42 stands rejected under 35 U.S.C. §103 as being unpatentable over Stevens in view of United States Patent No. 5,552,341 to Lee. Applicant respectfully traverses this rejection.

Claim 42 depends from independent Claim 3, and therefore includes all of the features of Claim 3, plus additional features. Accordingly, Applicant respectfully requests that the §103 rejection of dependent Claim 42 be withdrawn considering the above remarks directed to independent Claim 3, and also because the Lee reference does not remedy the deficiencies in the Stevens device discussed above, nor was this reference relied upon for the features discussed above.

Claims 43 and 45-47 stand rejected under 35 U.S.C. §103 as being unpatentable over Stevens in view of United States Patent No. 5,612,25 to Mu et al. Claims 45-47 have been cancelled, without prejudice, thereby rendering this rejection moot with respect to these claims. However, with respect to claim 43, Applicant respectfully traverses this rejection.

Claim 43 depends from independent Claim 3 and therefore includes all of the features of Claim 3, plus additional features. Accordingly, Applicant respectfully requests that the §103 rejection of dependent Claim 43 be withdrawn considering the above remarks directed to independent Claim 3, and also because the Mu et al. reference does not remedy the deficiencies in the Stevens reference, as discussed below.

In the July 8, 2003 Office Action, the Examiner correctly acknowledged that the Stevens reference failed to disclose an Al_2O_3 diffusion barrier and a copper

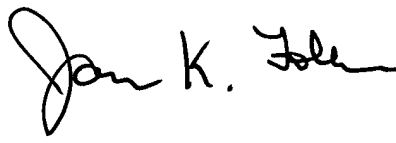
electroconductive layer. Accordingly, the Examiner relied upon the Mu et al. reference for the proposition that it would have been obvious to include an Al₂O₃ diffusion barrier and a copper electroconductive layer. However, even assuming *arguendo* that the Mu et al. reference could be combined with the Stevens reference, Applicant respectfully submits that it would not have been obvious to have arrived at the invention defined by independent Claim 1 and by dependent Claim 43.

Applicant respectfully submits that the Mu et al. reference teaches that when a metal layer (such as a Cu layer) is used, a barrier layer must also be included to prevent the metal layer from diffusing into the dielectric layer. *See e.g.*, col. 4, lines 65-67; col. 6, lines 27-33; col. 6, lines 52-55. Further, the Mu et al. reference fails to disclose or suggest that any layers may be included between the metal electroconductive layer and the barrier layer. That is, the Mu et al. reference discloses that the metal electroconductive layer is formed directly above the barrier layer. *See e.g.*, Figure 8, which shows Cu layer 61 formed directly upon barrier layer 60. In contrast, in the present invention of Claim 3, the electroconductive layer is formed directly on either the metal growth promoting layer, and not directly on the barrier layer. Accordingly, as all of the features of independent Claim 3 are not disclosed or suggested in the Stevens and the Mu et al. references, Applicant respectfully requests the withdrawal of the this §103 rejection of dependent Claim 43, which refers back to independent Claim 3.

For all of the above reasons, Applicant requests reconsideration and allowance of the claimed invention. Should the Examiner be of the opinion that a telephone conference would aid in the prosecution of the application, or that outstanding issues exist, the Examiner is invited to contact the undersigned.

Respectfully submitted,

GREER, BURNS & CRAIN, LTD.

By 
James K. Folker
Registration No. 37,538

October 8, 2003

Suite 2500
300 South Wacker Drive
Chicago, Illinois 60606
(312) 360-0080

Customer No. 24978

K:\1508\63671\amd-e.doc